Supporting Land Use and Transportation Planning Integration with GIS

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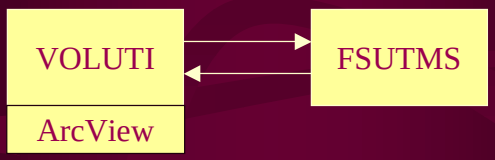
Introduction

- Link exists between transportation and land uses
- Land use planning and transportation planning are not well integrated
- Elected officials and the public do not understand transportation models well
- A visual approach is needed for decision making and public involvement

Goals and Objectives

- Provide information to decision makers and the public concerning transportation investments and land developments
- Develop a GIS based prototype computer tool to
  - visualize land use and transportation information
  - explore useful planning information
  - link to a travel demand model
  - perform quick analysis of land use and transportation project impacts

Development of VOLUTI



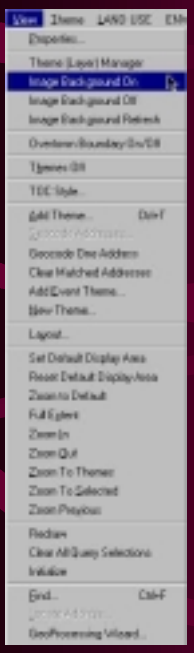
- VOLUTI
  - Visualization of Land Use and Transportation Interaction
  - Not a land use forecasting model at present
- FSUTMS - Florida Standard Urban Transportation Model Structure (TRANPLAN)

Design of Prototype Software

- ArcView based
- Customized with Avenue
- Predefined queries
- Menu driven
- Link to FSUTMS

Menu Structure

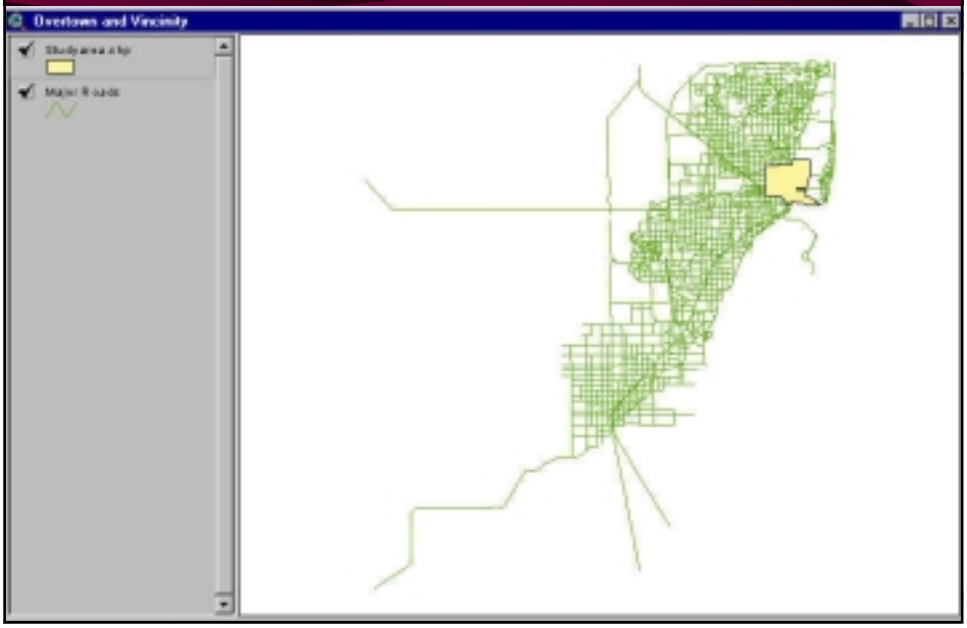
- Menus enhanced and created
  - View
  - Land Use
  - Environment
  - Socioeconomic
  - Transport Facility
  - Accessibility
  - Site Development
  - Travel Demand

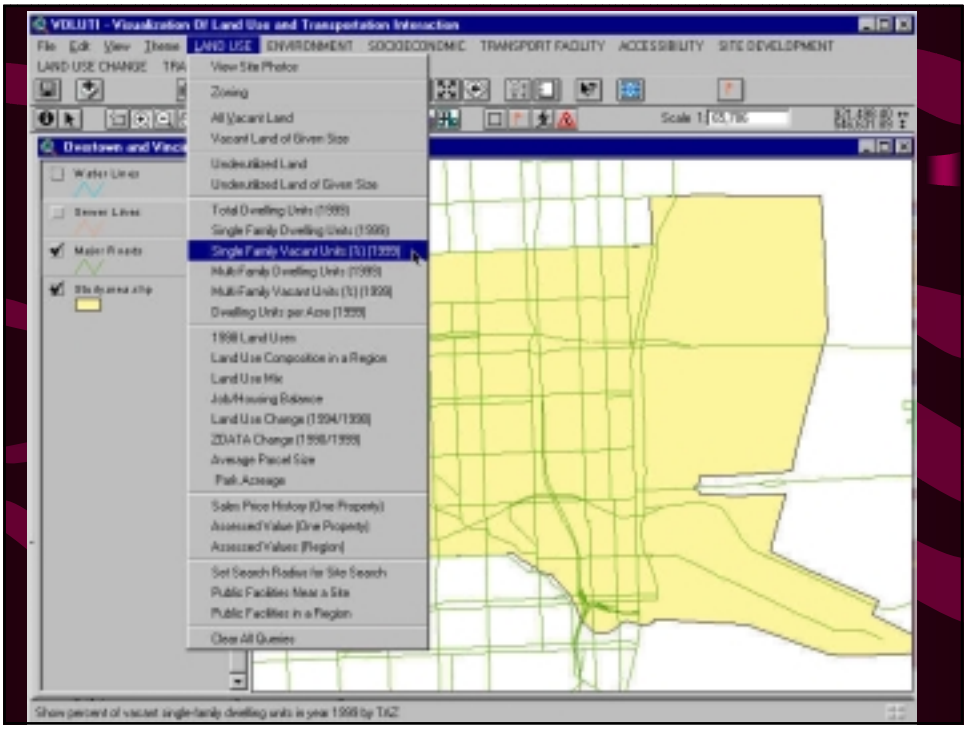


Enhanced View Menu

- Theme manager
- Image background (DOQQs)
- Study area boundary
- Display area management
- Clear queries

Study Area - Overtown





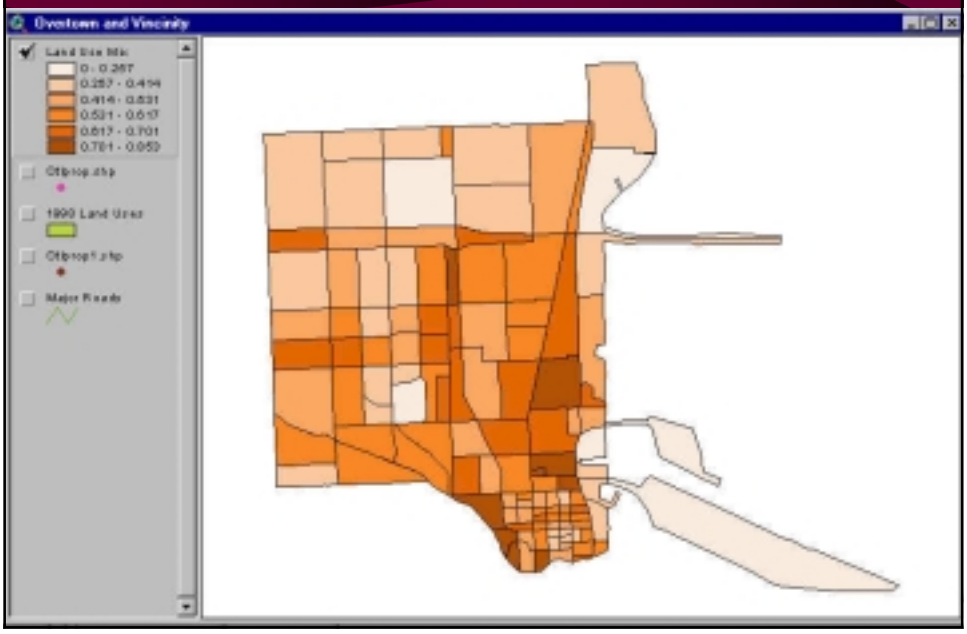
Land Use Mix Index

$$Entropy = -\sum_{j=1}^{J} \frac{p_j \ln(p_j)}{Ln(J)}$$

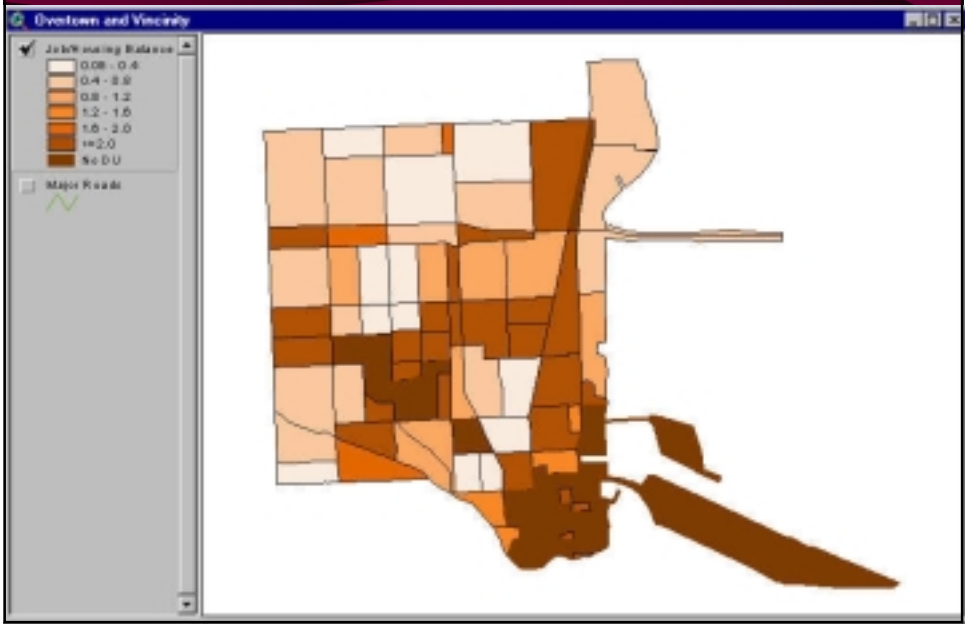
P_j proportion of land use j in grid cell j

J total number of different land uses

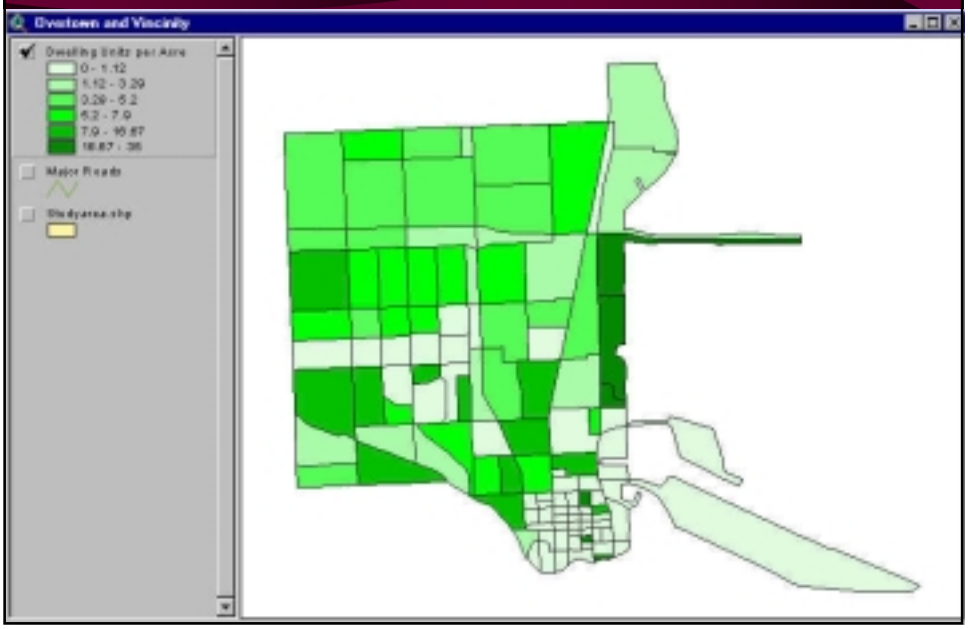
Land Use Mix



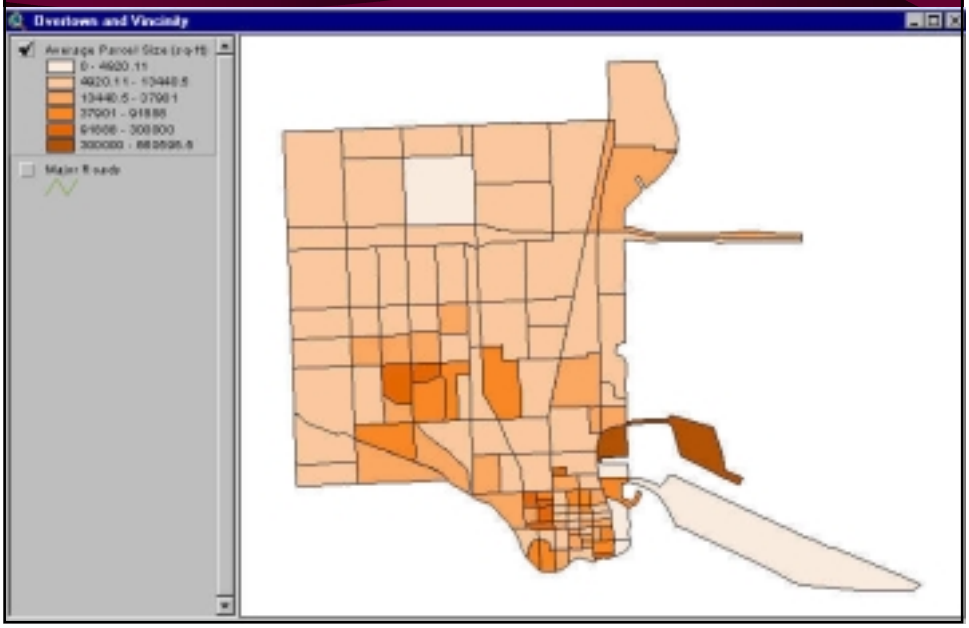
Job/Housing Balance



Dwelling Units per Acre

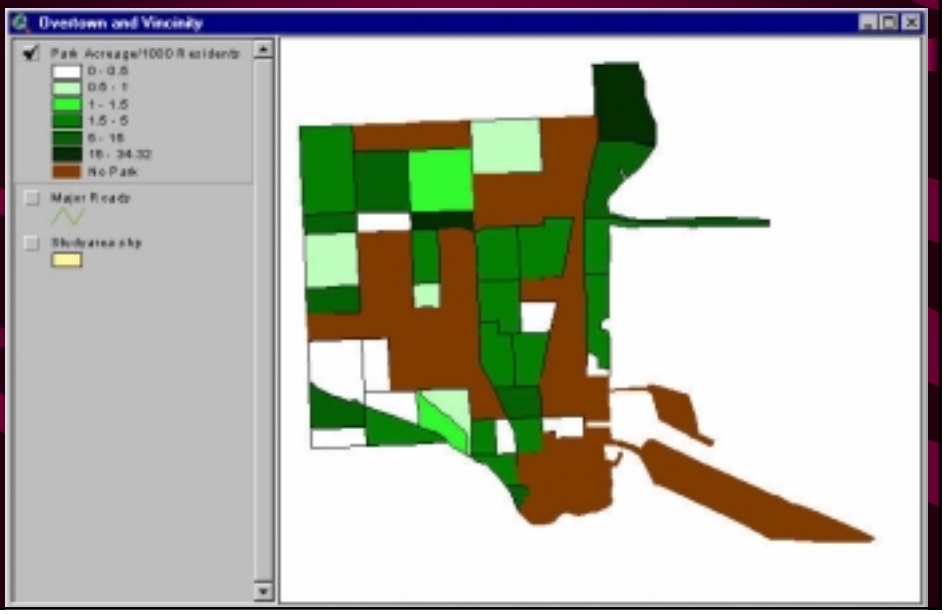


Average Parcel Size by TAZ
(potential for assembly of large parcels)

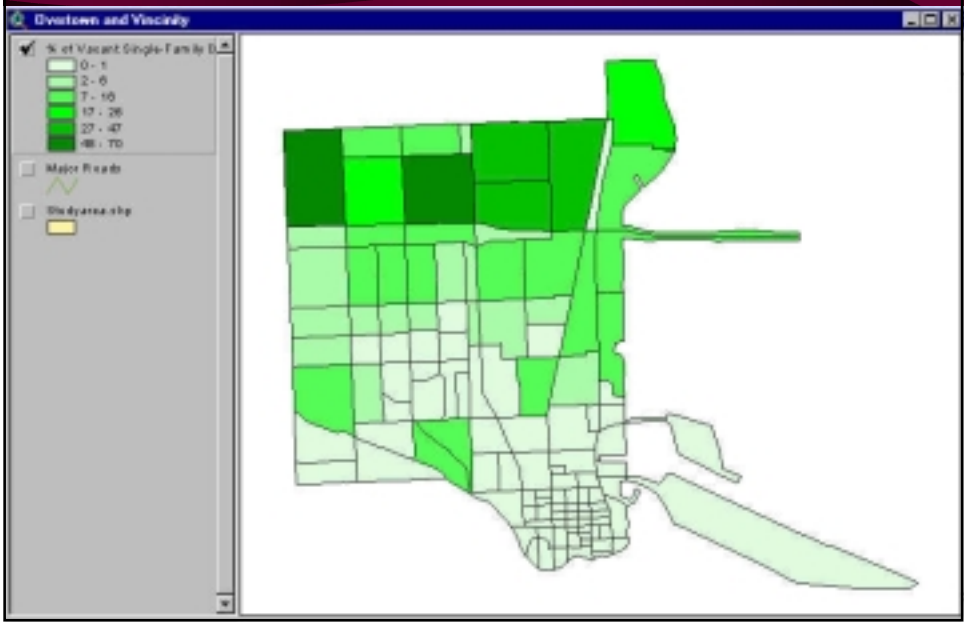


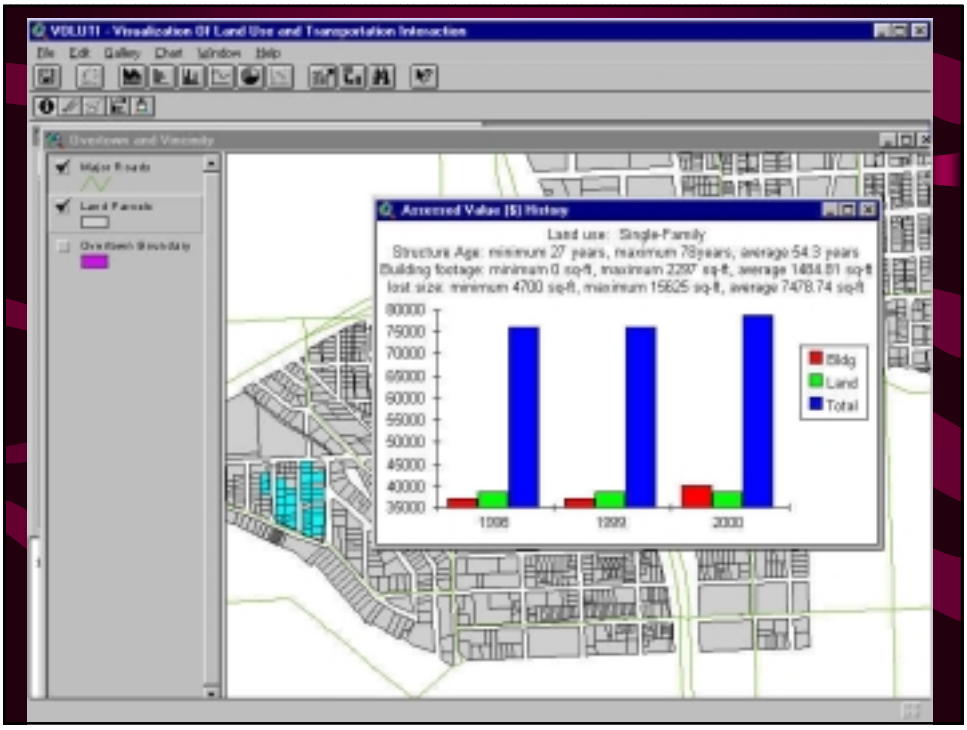
Park Acreage per 1000 Residents

(1.5 acres per 1000 residents required)

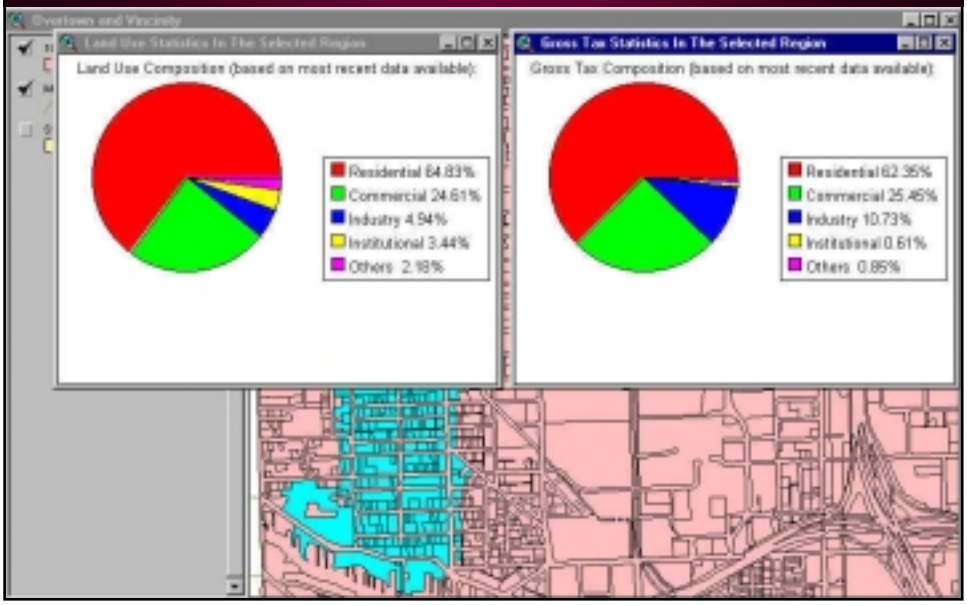


% of Vacant Single-Family DUs

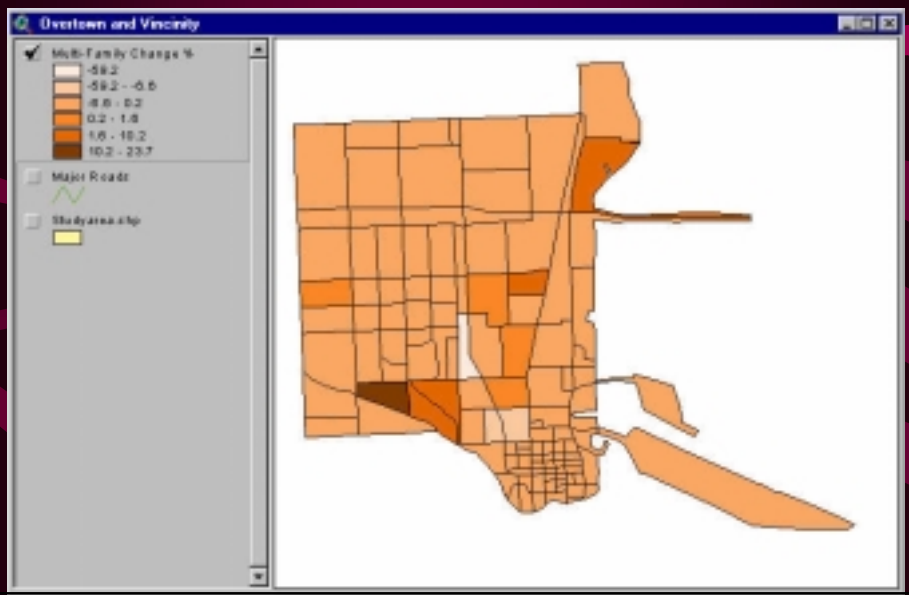




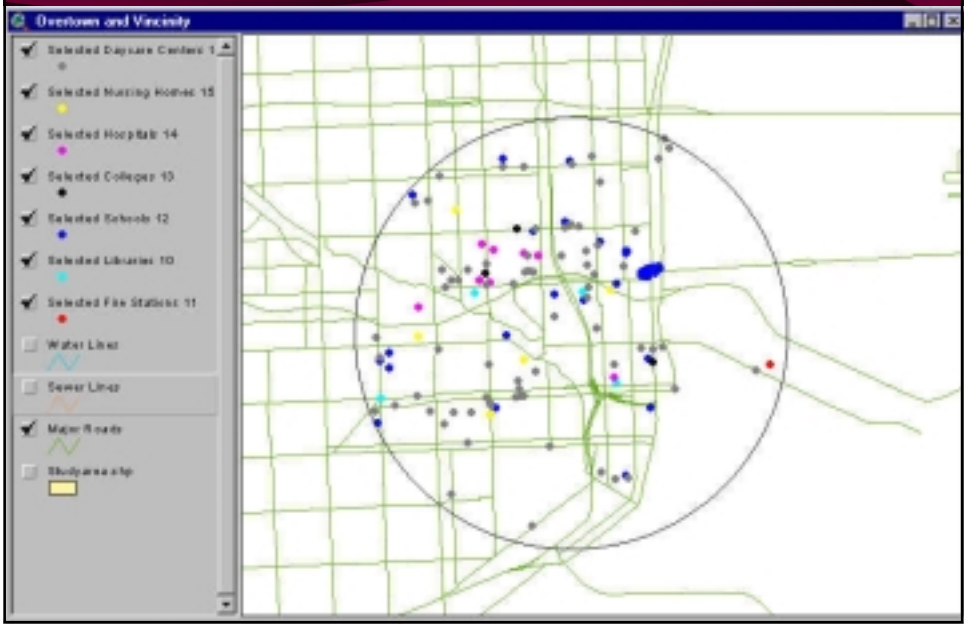
Land Use and Tax Base Makeup



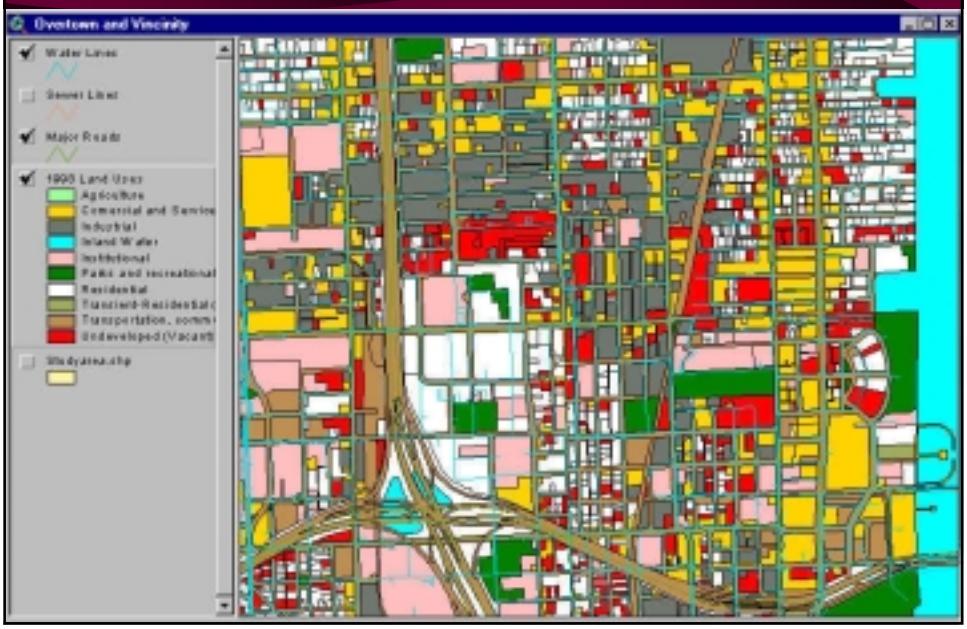
Land Use Change between 1994 and 1998



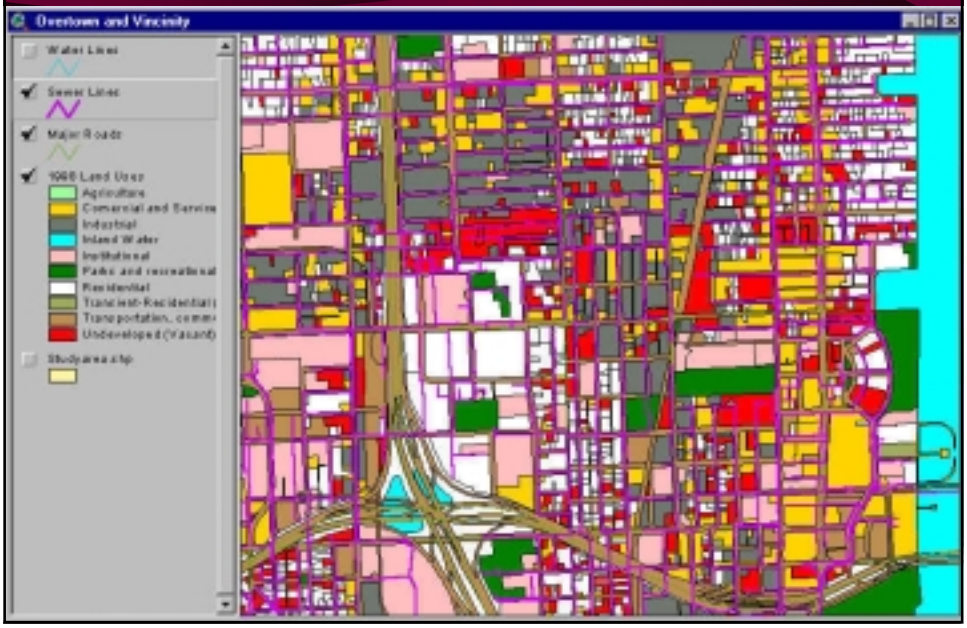
Public Facilities in a Selected Area

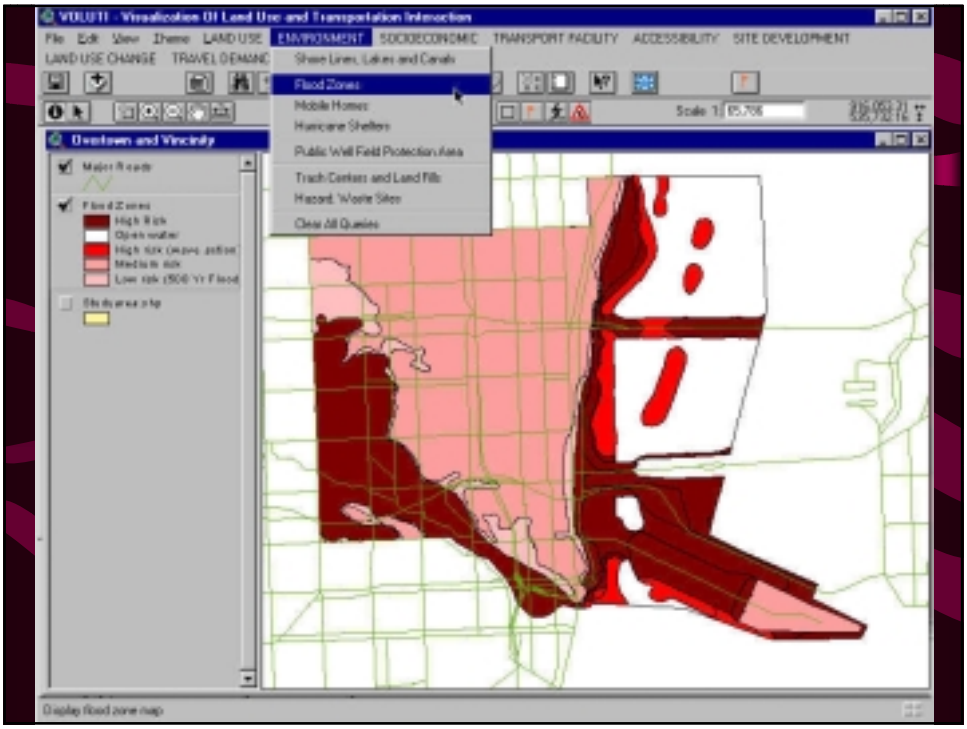


Water Supply and Land Uses

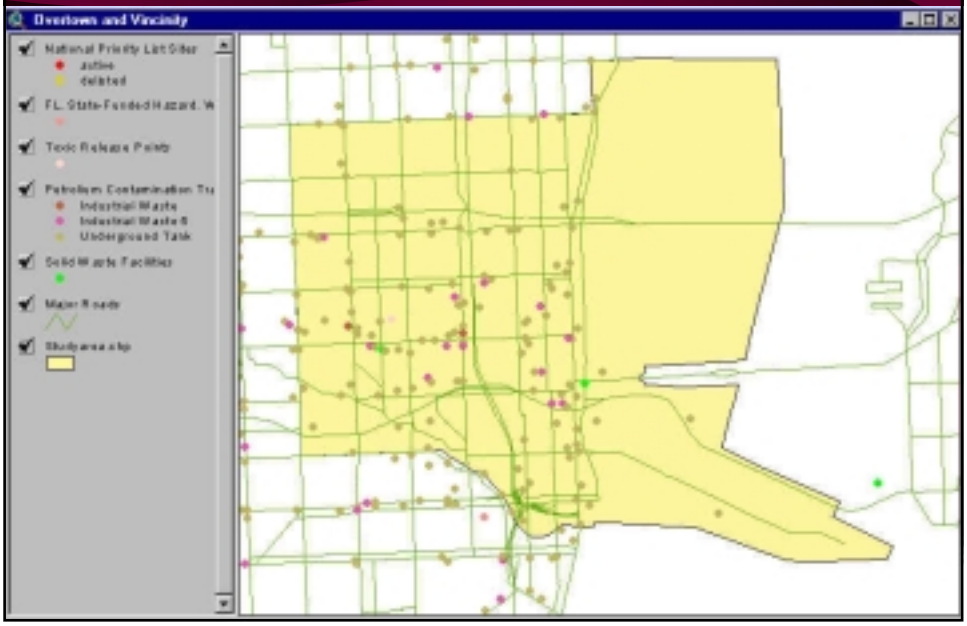


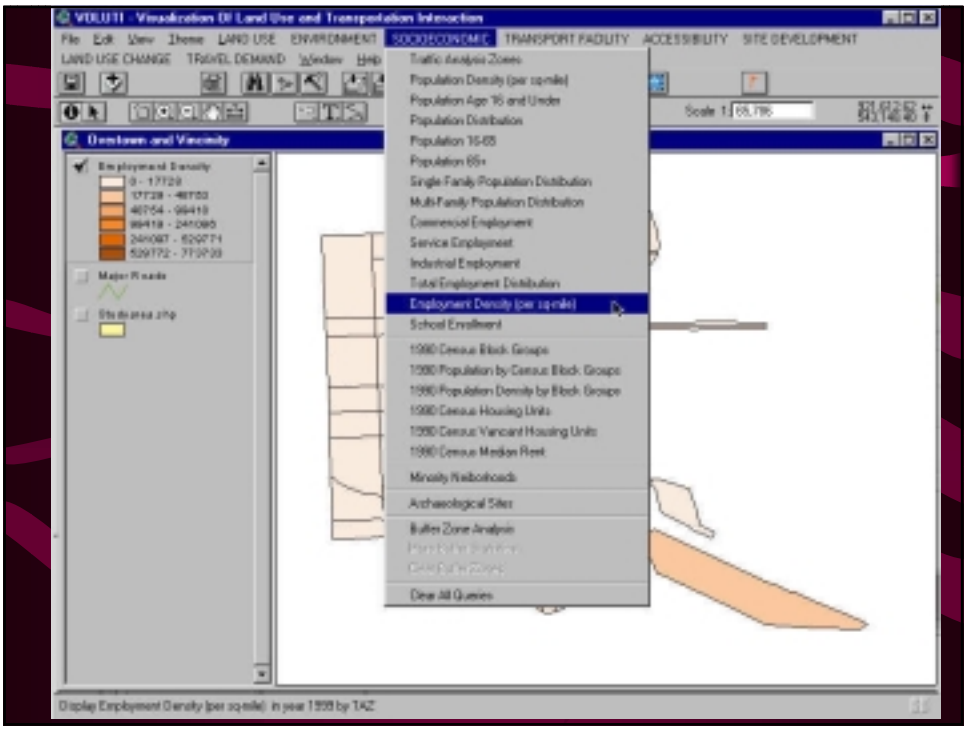
Sewer Lines and Land Uses



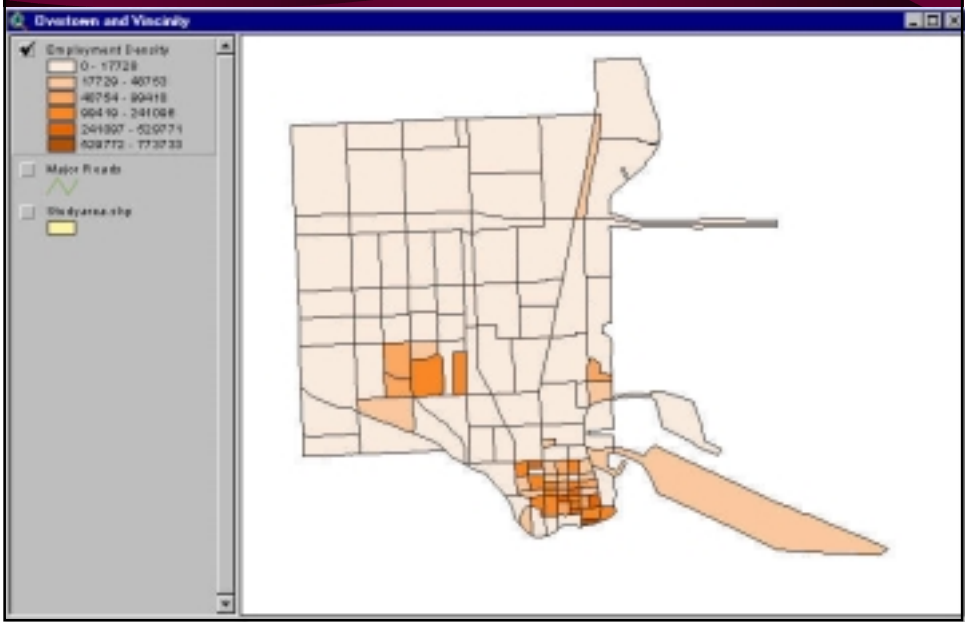


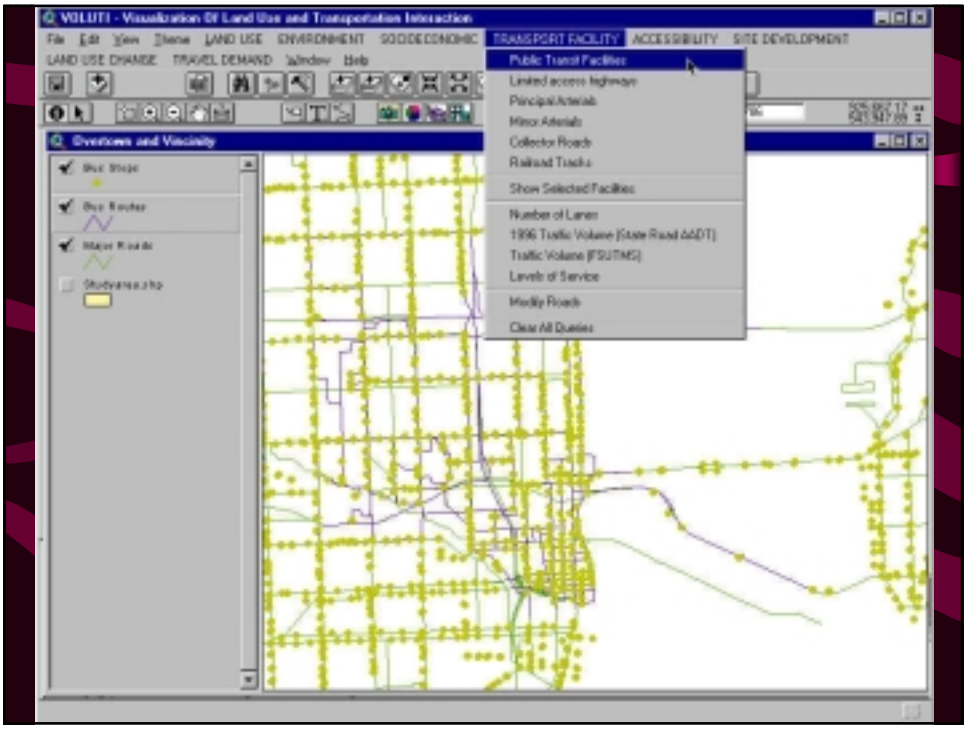
Environmental Hazards





Employment Density



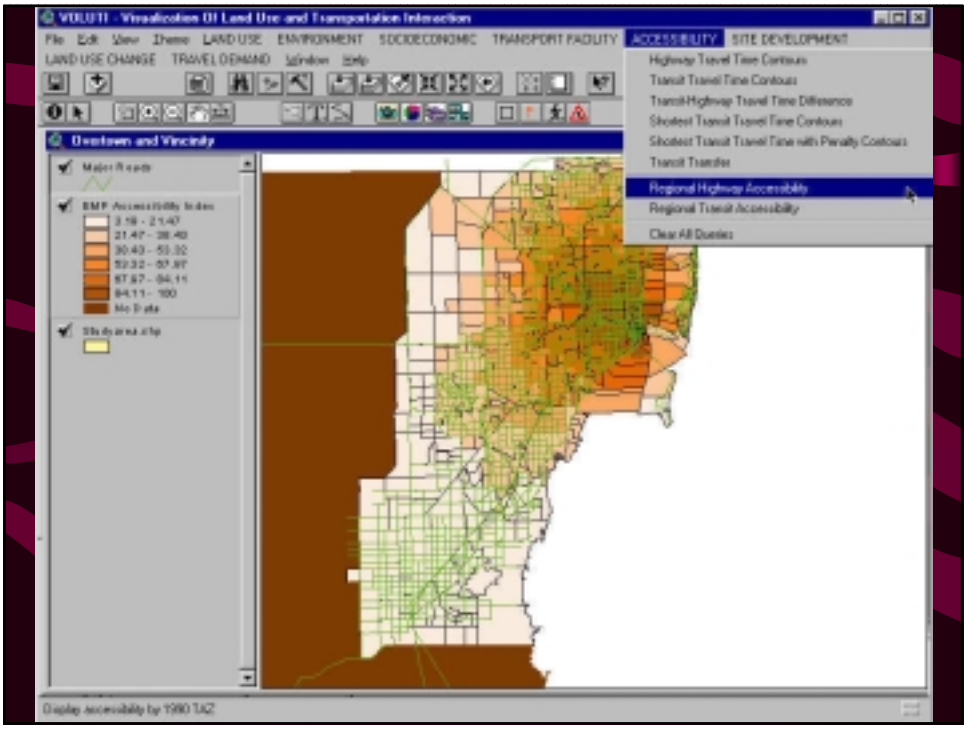


Regional Employment Accessibility Index

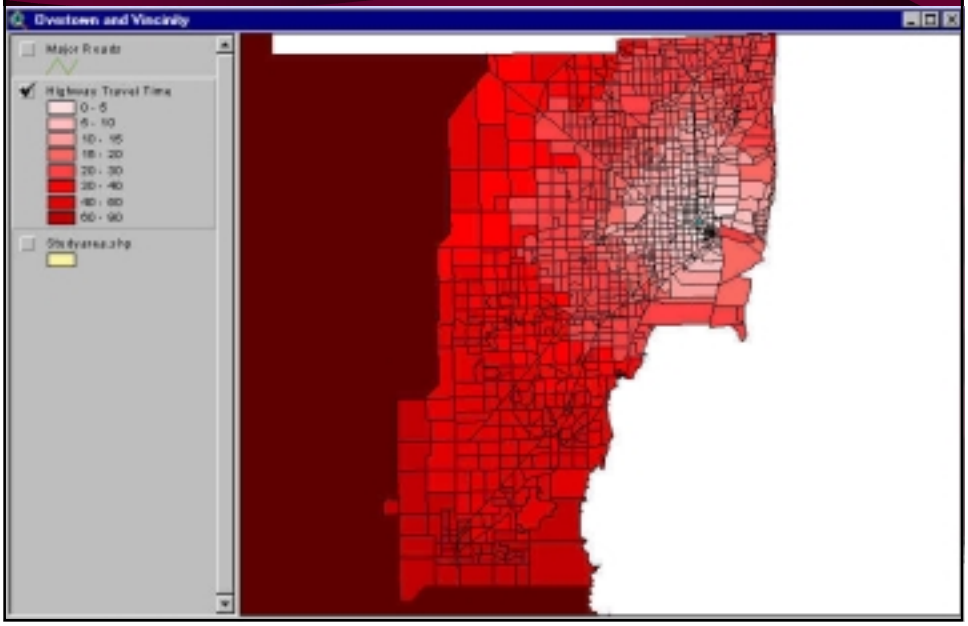
$$RAE_i = \left| \frac{100}{RAE_{\max}} \right| \sum_{j=1}^{N} Emp_j \exp(-0.0954 \times t_{ji})$$

Emp_j - Employment of Zone j

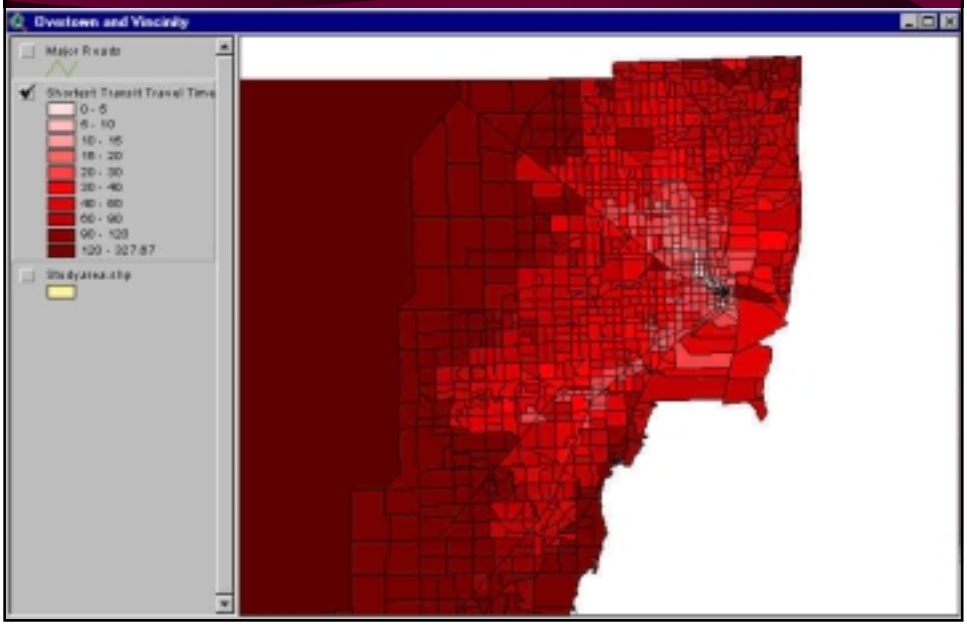
t_{ji} - travel time between Zone j and Zone i



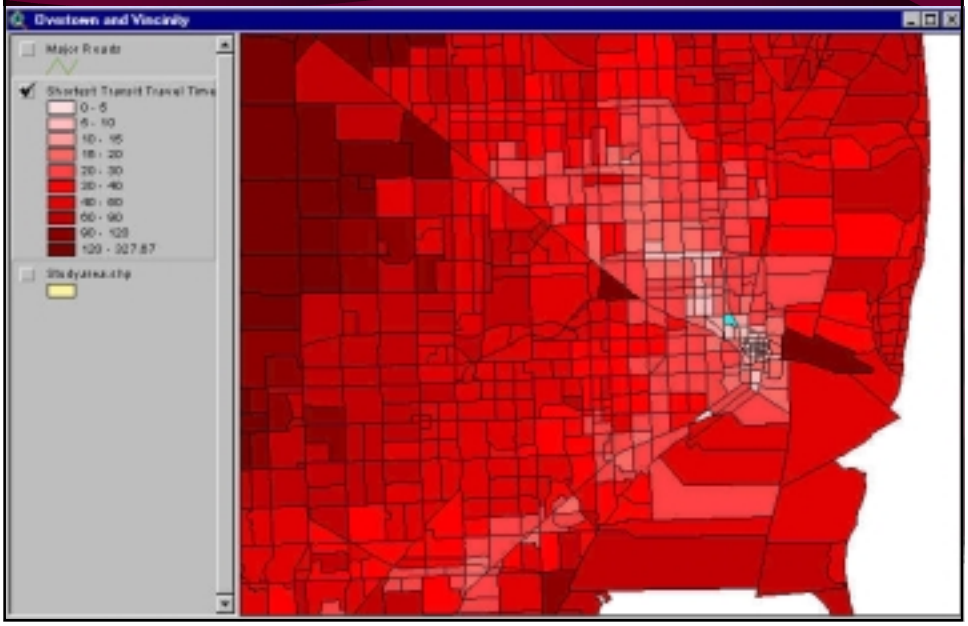
Highway Travel Time Contours



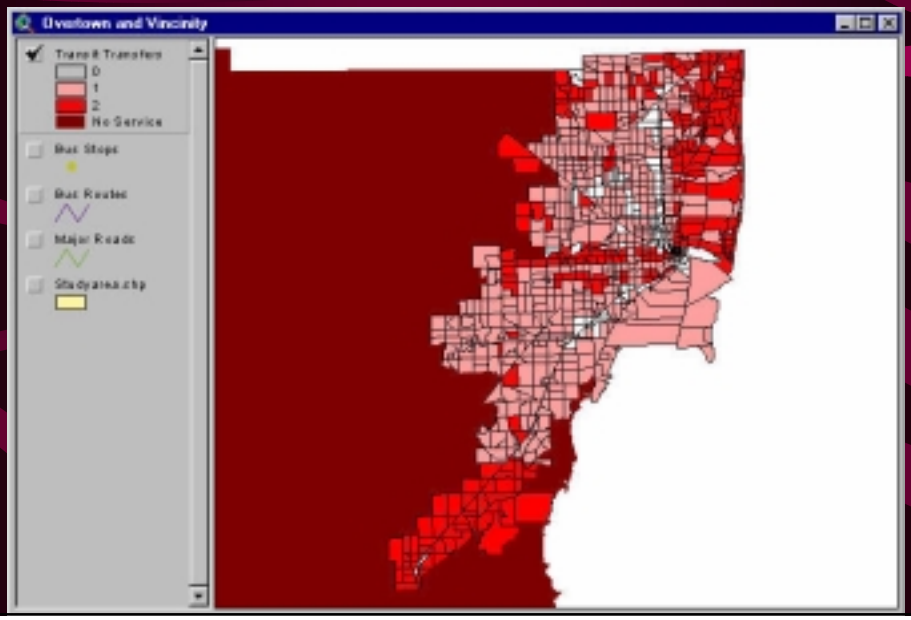
Transit Travel Time (All Modes)



Transit Travel Time (detail)



Transit Transfers Required



Site Impact Analysis (DRI)

- Quick analysis of potential large developments
- Determine needed transportation investments

Site Impact Analysis Overview

- Study area (Area of influence): Miami-Dade County urban network
- Analysis year: 1990 currently
- Approach: combination of manual and modeling techniques
- Back ground traffic: 1990
- A major model update effort is underway

ITE Land Use Types and Land Use Codes

110. General Light Industrial
210. Single-Family Detached Housing
220. Apartment
310. Hotel
320. Motel
411. City Park
565. Day Care Center
834. Fast-Food Restaurant with Drive-Through Window
852. Convenience Market (Open 15-16 Hours)
870. Apparel Store
911. Walk-in Bank

Land Use Intensity Units

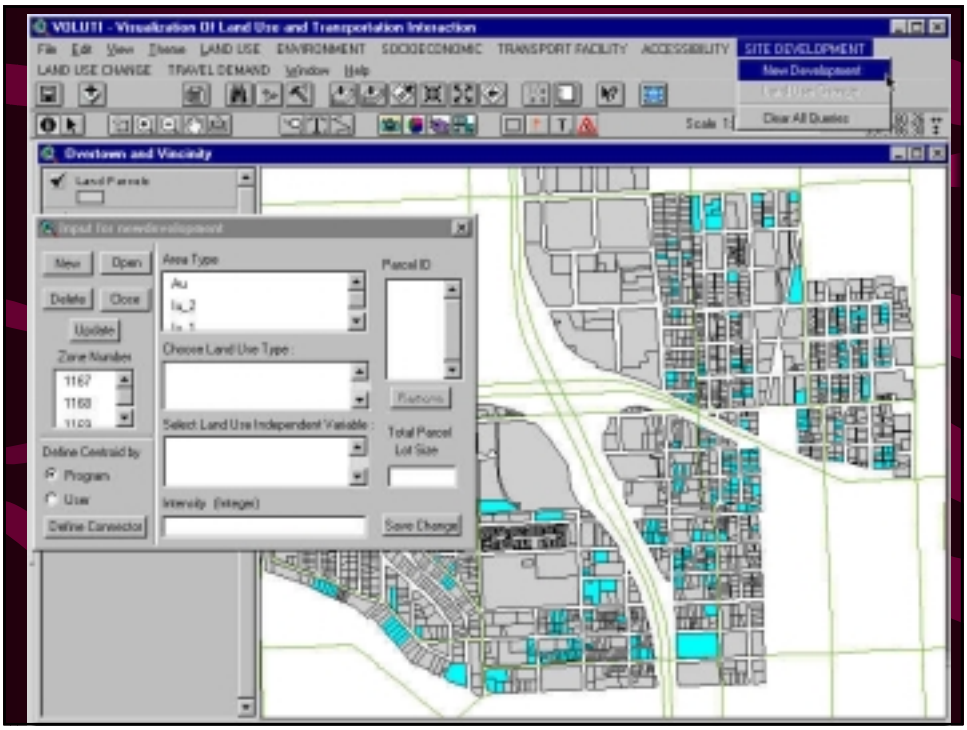
- Dwelling Units
- Persons
- Vehicles
- Employees
- 1000 Sq. Feet Gross Floor Area
- Acres
- Occupied Rooms
- Rooms
- Picnic Sites
- Students
- Seats
- PM Peak Hour Traffic on Adjacent Street

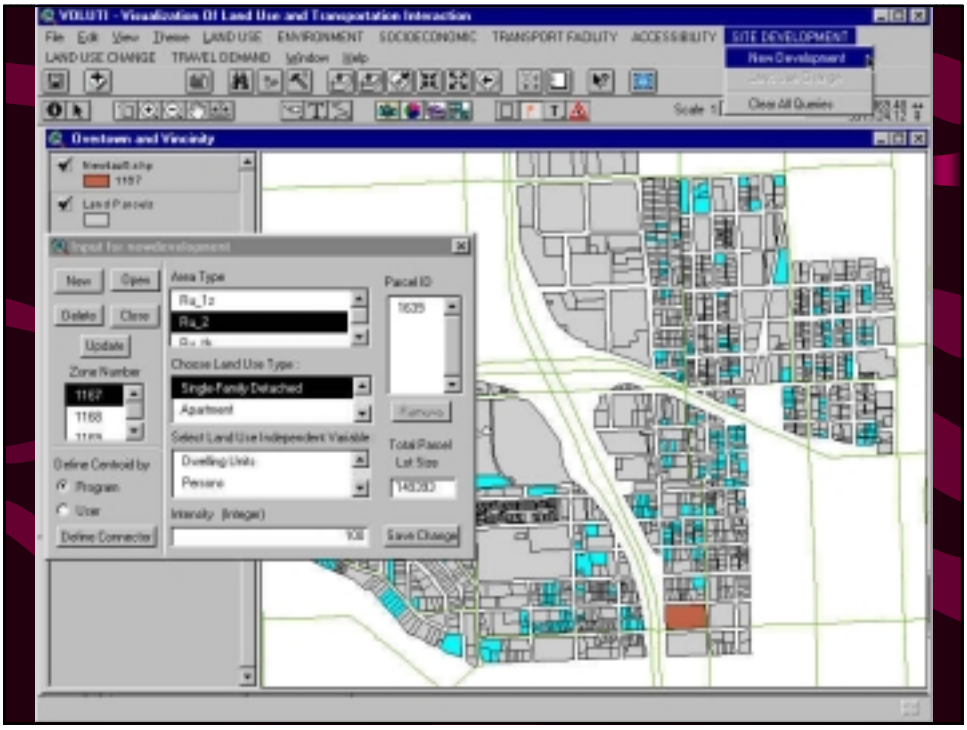
Zoning Code Requirements

- New land development need to
  - satisfy land use types permitted by zoning
  - Has the minimum lot size required by zoning code

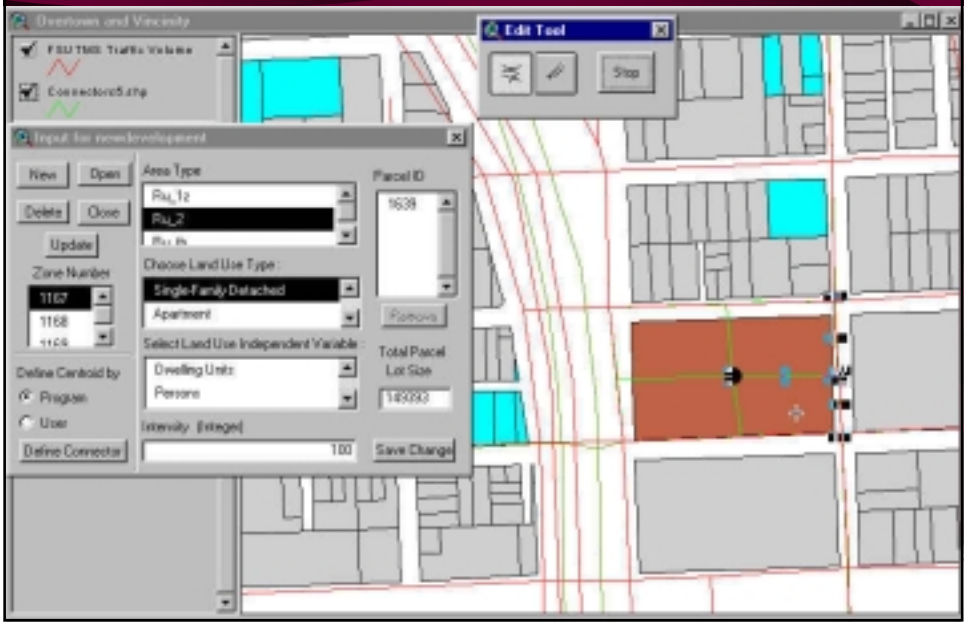
Site Impact Analysis

- Define new TAZ(s) in VOLUTI GIS interface for new development(s)
- Use FSUTMS to forecast the behavior of development-generated trips within the site impact process

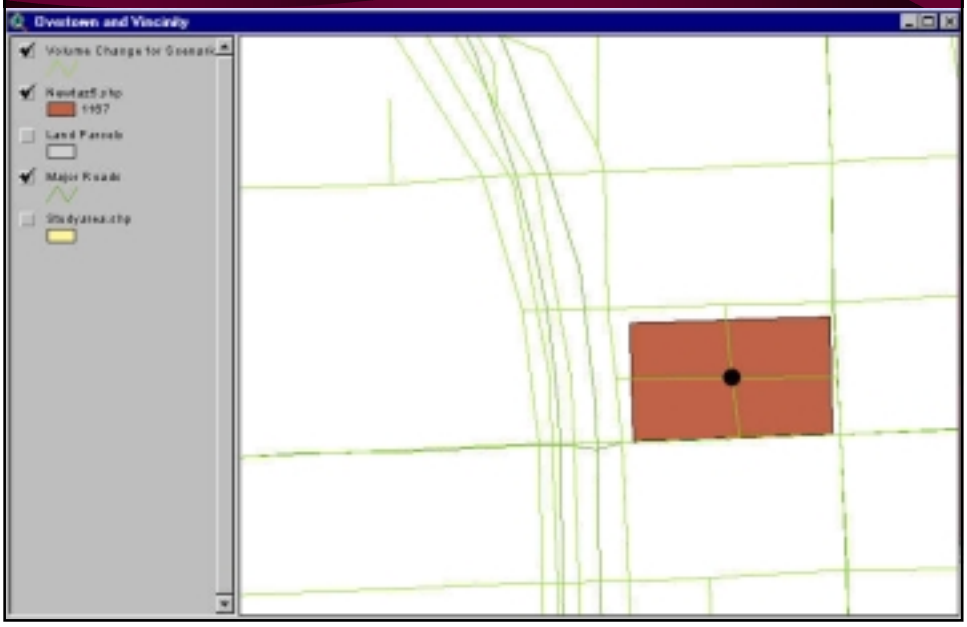




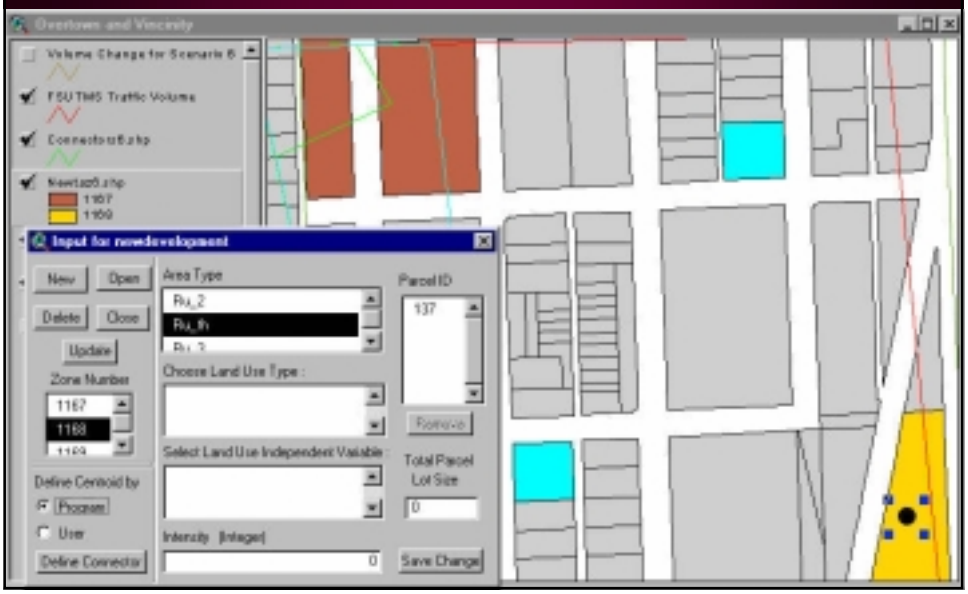
Centroid and Network Connector Editing



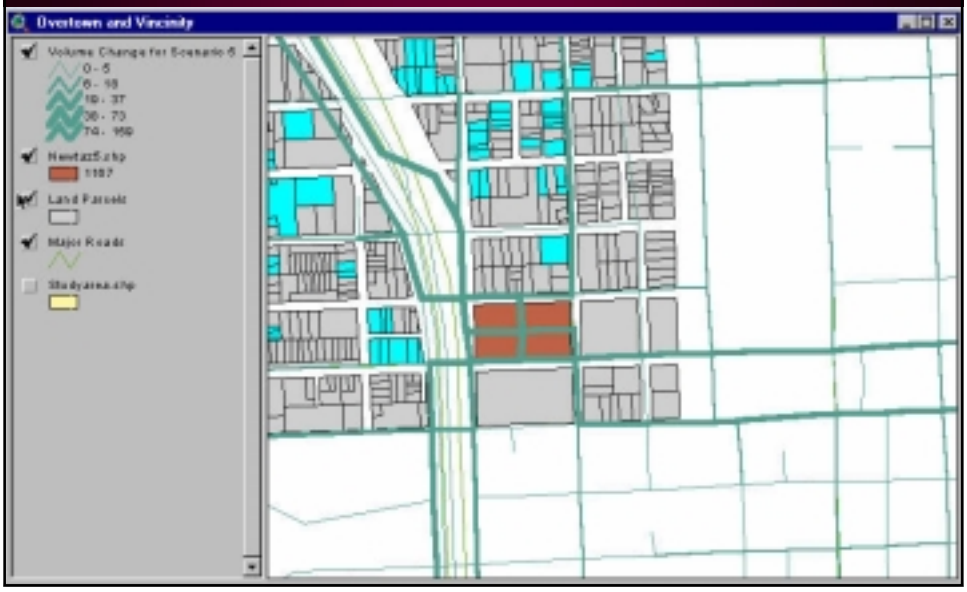
A Completely Defined Scenario



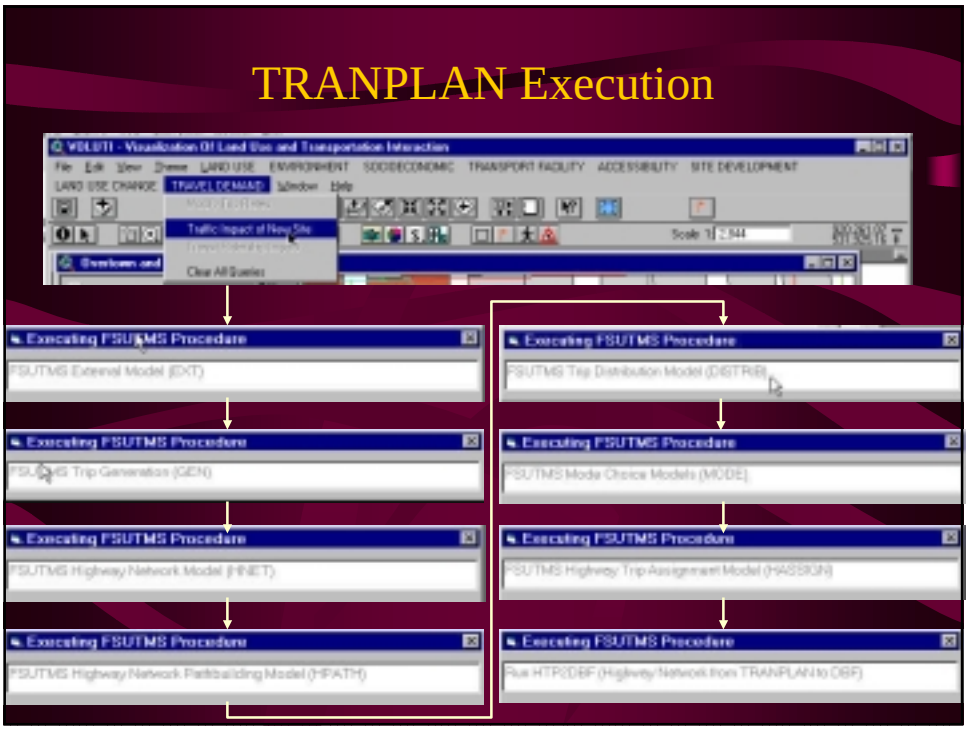
Multiple Parcel, Multiple TAZ Scenarios



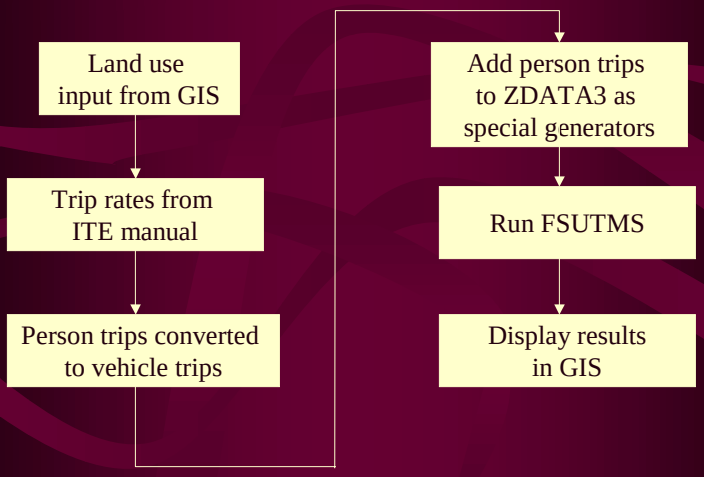
DRI Induced Traffic



TRANPLAN Execution



General Methodology



Site Impact Analysis Steps

- Existing conditions & background traffic
- Trip generation
- Trip distribution
- Mode split
- Assignment

Existing Conditions & Back Ground Traffic

- 1990 Miami-Dade transportation model
- Number of internal zones: 1,179
- Total number of zones: 1,200
- Number of links = 14,736

Trip Generation Steps

- Estimate trip generation using ITE trip generation rates
- Convert ITE-based vehicle trips into productions & attractions
- Convert P & A vehicle trips to different purposes
- Convert vehicle trips to person trips for different trip purposes
- Adjust special generator (ZDATA3) input attractions

Estimate Trip Generation Using ITE's Trip Generation

- 110: General Light Industrial
- 210: Single-Family Detached Housing
- 220: Apartment
- 310: Hotel
- 320: Motel
- 411: City Park
- 565: Day Care Center
- 710: General Office Building
- 820: Shopping Center
- 834: Fast-Food Restaurant With Drive Through
- 852: Convenience Market
- 870: Apparel Store
- 911: Walk-In Bank

Convert ITE Trips to P & A

- Proportion ITE vehicle trips to P & A based on the land uses of the new developments
- Attractions for land use codes 210 & 220 = intensity * AOFAC(5)
- Apply area-wide averages for land use codes 310 & 320
- Attractions = ITE trips for the other land uses

Convert P & A to Trips by Purpose

For Land Uses 210 & 220

- HBW & HBS Attrs = 0
- HBSR Attrs = 0.5*Intensity*AOFAC(5)
- HBO Attrs = 0.2*Intensity*AOFAC(5)
- NHB Attrs = ½ *0.3*Intensity*AOFAC(5)
- NHB Prods = 0
- Area-Wide Averages for the Other Productions

Convert P & A to Trips by Purpose

For Land Uses 310 & 320

- Area-Wide Averages for All Purposes

For Other Land Uses

- Area-Wide Averages for All Attractions

Vehicle Trips to Person Trips for Different Purposes

- Convert vehicle trips to person trips by dividing vehicle trips with the associated AOFAC parameters in PROFILE.MAS

Special Generator(s) Adjustment

For Each Trip Purpose:

- Compute the unadjusted totals for both production & attraction
- Compute total new productions
- Multiply new development attractions with (total unadjusted attractions) / (total productions + new productions)

Trip Distribution

- Currently, no adjustments made to the results of the model trip distribution

Mode Split

- Perform selected zone analysis
- Convert trips to vehicle trips

Selected Zone Analysis

- Generate trip table for development trips only
- Convert total trips and development trips from person trips to vehicle trips
- Join total vehicle trip table and development vehicle trip table - total trips for purpose 1, development trips for purpose 2

Assignment

- Currently, perform highway only assignment
- Feed the assigned development trips (purpose 2) to VOLUTI for display purpose

Some Practical Issues

- Interpolation between base year and forecast year
- Maintenance of a database of new and committed land development projects
- Maintenance of a network reflecting new and committed transportation improvement projects
- Maintenance of a transit network reflecting new and committed services

Conclusions

- Transportation and land use information need to be understandable by non-planners
- GIS is a useful environment and tool for planners
- Decision support within GIS needs more study
- GIS data collection and maintenance need to be coordinated among different agencies
- Historical data are needed
- Model integration is desired
- 3D and virtual reality models useful but expensive

Acknowledgements

- David Korros - FDOT District VI
- Jill Strube - Metro Center, FIU
- Lee-Fang Chow - FIU
- South Florida Planning Council
- Frank Baron - Miami-Dade County MPO
- Miami-Dade County Water and Sewer Dept.
- Miami-Dade County Information Technology Div.
- Florida Dept. of Children and Families